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Age of the Beginning of the food Diversification and the Risk of Obesity in the Children from 0 to 42 Months in Miramichi (Canada)

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Abstract: *The present study was led to assess the age of the food diversification, and to identify the socio-demographics factors related to the age of the early food diversification in the Miramichi region. A cross-sectional study was performed. A total of 294 children aged from 0 to 42 months were included in the study. The data collection concerning the food and the beginning of the food diversification was done by questionnaire addressed to the parents. A bivariate and a multivariate statistical analysis was realized to identify the determinants of the early age diversification. The adjusted Odds Ratio (ORa) and their interval were calculated. The age of the onset of food diversification is of 13, 1 months. In multivariate analysis, the age of the onset of the food diversification is related to the maternal age (adjusted odds ratio (ORa) = 1.2), to the mother and father's education level (ORa = 1.6), to the mode of feeding (ORa = 1.9), and to the duration of breastfeeding (ORa = 2.2), which are predictors factors of childhood obesity in Miramichi. The age of the onset of food diversification in the Miramichi region is far from that recommended by the World Health Organization. This first analysis suggests that the early food diversification is associated both with the family situation, in relation with the employment, the factors related to the education and to the method and the duration of breastfeeding.*
Keywords: *Age, diversification, duration, associated factors, risk of obesity, Miramichi*

I. Introduction

The food diversification is the introduction of foods other than breast milk, except the vitamin and the mineral supplements, water and oral rehydration solutions [1]. This introduction represents a physiological, sensorial and psycho-affective phase of adaptation to an autonomous and omnivorous diet. In industrialized countries, the diversification is defined by the introduction of solids foods in breastfeed child or receiving infant formula [2]. The diversification comes at a period of life when the method or the type of feeding can influence on a long time the health of the individual by some mechanisms so-called «programming". It has nutritional immunological and psychological consequences. In fact, the introduction of common foods in infants feeding can quickly lead to nutritional imbalances, and can lead to the risk of allergies. That is why special attention should be paid to components of food in terms of quality and quantity in order to meet these nutritional recommendations. According to the WHO's instructions in 2006 [3], the beginning of the diversification in healthy child should not start before six months if they are breasted or not. The Canadian Pediatric Society [4], is in agreement with the principles established the WHO, in introducing solids food at the age of six months. The food diversification period, characterized by both fundamental changes in the child's diet and a significant speed of growth, could represent a sensitive period during which the nutritional influences would have long term effects on the development and the subsequent health. The food diversification effect on infant growth and the later obesity risk has been the subject of few studies in comparison with the breastfeeding. The majority of works do not show clear association between the age of introduction of foods and subsequent overweight [5].
Few data are available on the role of the diversification in the development of obesity risk and the modalities of implementation of the diversification in infants, who have varied considerably on a long period, influenced by the socio-cultural and economic conditions, the family eating habits. The objective of this study was to describe the maternal factors associated with early food diversification before 6 months from the mothers of the Miramichi region. The specific objectives are: estimate the age of diversification; identify the characteristics associated with the cessation of the early diversification.

II. Material and Methods

2.1 Type of Study

It is a descriptive cross-sectional study, realized on a representative sample

2.2 Studied population

The target population of the study is composed of all children aged from 0 to 42 months, lactating mothers and fathers in the Miramichi of New Brunswick in Canada.

2.3 Progression of the study

A questionnaire has been realized according to the recommendations of the Public Health Agency of Canada, Health Canada, the Canadian Pediatric Society and Dietitians of Canada over the age of food diversification. In addition to the questionnaires, information was collected from the medical records of the mother and child. The dependent variable of the study is the age of food diversification. At each measurement time, the mother should answer by yes or no, if she began the food diversification of her child. The independent variables are the factors related to the mother, the father and the child.

2.4 Construction of variables of the type of diversification food

The food diversity, indicator of the food quality, is defined as the number of different food groups consumed over a given period of time. The food consumption of 3 to 42 months were collected in the study by means of a short frequency questionnaire composed of items. These items were specifically linked to the consumption of fruits and vegetables, grains, dairy products, and meats and replacing, pastries, and were grouped into 5 categories. Our initial goal was to analyze the links between early feeding practices, and the consumption frequency of fruits and vegetables, meat, fish, starchy foods, and pastries, before 6 months, in order to verify that the observed effects were specific to the consumption of food diversification.

2.5 Statistical Analysis

The data were recorded on Software SPSS, Version 21, and analyzed. These are used to estimate the association between the target variables and the dietary diversification age. This first step identifies the variables included in the regression model. Finally, the logistic regression analysis has permitted to identify the factors that better explain the age of diversification with a significance level of 5%. The data analysis has two components: a univariate analysis, to search for possible correlations between the dietary diversification age and the different associated variables; a multivariate analysis, by logistic regression, with a significance level of 5%.

III. Results and Discussion

The bivaried analysis of the early diversification of age showed an association with the maternal age ≥ 35 (OR = 2.23: 95% (1.60 to 2.85) p = 0.001); it was also associated with marital status (OR = 1.97: 95% (0.60 to 1.75) p = 0.001), the level of education (OR = 1.6: 95% (1.4 to 2.6) p = 0.001), smoking (OR = 2.62: 95% (1.44 to 4.78) p <0.001), the type of feeding (OR = 1.4: 95% (0.4 to 2.7) p = 0.00) and the duration of breastfeeding (OR = 2.4: 95% (1.1 to 3,10) p <0.001). The table summarizes the results the results of the bivaried analysis by logistic regression (Table 1).The multivariate analysis by logistic regression has showed that among the seven factors significantly associated with the early age of food diversification, only five were independent factors (Table). Indeed, the early diversification of age was higher among the younger women (p = 0.009), the married women or in couples (p = 0.005) and in the type of breastfeeding and the smoking (p <0.05) (Table 2).The delay of introduction between each category of food was studied. The introduction of early fruit juices and the consumption of cereals, milk and substitute, meat and substitute, were frequent before the age of 6 months; 85% of children had already tasted. We see that a majority of women questioned, had introduce in addition to milk, soft drinks before or during the period of the diversification (Figure 1).

This study aimed to describe the factors associated with the breastfeeding cessation before six months. The food diversification was started early, before 6 months, in 52% of young children. Factors encouraging this early contribution were the maternal age, the level of mothers study, and the absence of continued breastfeeding. This study has showed that the maternal age is a factor favoring the early age of food diversification. This association could be explained by the increasing age. Indeed, the age of diversification is significantly higher in older mothers than among the young mothers; in fact the young mothers were 1.9 times more risk of diversify early the diet of their child than older mothers . This early diversification related to the age was also reported by other studies [6, 7]. The mother age remains an important criterion and is associated with the dietary diversification.In this work, we have obtained a positive correlation between the marital status of the mother and the age diversification (OR = 2.7; p <0.001). The marital status constitute a factor significantly associated with the early diversification [8,9].Some studies show that married mothers introduced the solid food very later compared to the women alone [10,11]. In this work, we have also obtained a positive correlation between the level of study of the mother and the age of diversification (OR = 1.8; p <0.001). The low level of education of mothers and fathers was reported by several studies, given that there is a strong correlation between the education of the mother and of the father [12]. This association could be explained by the fact that the level of parental education can improve the income, the use of health services, the hygiene and the diet. Moreover, and specifically for the high level of education of the mother, it was reported that it predisposed to better manage the family resources, to better use of the health services; as in other studies in Canada, the level of education and

the age diversification are closely related. More the education level is high, more the diversification age is delayed. Thus, the half of women who left the community college studies practiced the early food diversification, against nearly 70% of those who have studied in High School Diploma or at the University or at the Post-graduate program [13]. We found in a study from Lille in France [14] that the mothers with the lowest level of education practiced the early food diversification and made more nutritional error. This is corroborated by other European studies [15].This study has analyzed the maternal smoking, given the risk to shorten the age of food diversification. The others who continued to smoke during the pregnancy and after the birth were 3.18 times more likely to diversify very early the diet because of the smoking [16] .In contrast, the mothers who stopped the smoking or decreased their consumption of cigarettes during pregnancy have a longer average duration of breastfeeding than those who do not change their tobacco habits, thus delaying the age of food diversification.The average duration of exclusive breastfeeding was 11.3 ± 7.7 weeks, and less than a quarter of the children were breastfed exclusively by the breastfeeding during more than 6 months. The duration of breastfeeding is greater than 10 weeks as revealed in the study of Branger [17] which covered all exclusive or mixed maternal feedings; that may suggest the existence of a progression, but one of the difficulties of comparisons with international studies available is that they are rarely on the duration of exclusive breastfeeding, but more on that of the mixed breastfeeding. It was however revealed that the observed rate of exclusive breastfeeding in the study at 4 months, is inferior to that observed in the Taveras's study in the USA [7], where it was of 53% and relatively close to that observed in Scott 's study in Australia where it was of 28% [18].Several studies have shown that the type of breastfeeding influences the period of food diversification. Thus, in a Swedish study of 2001, in children breastfed, only 34% had started solid foods at 4 months [20]. A Norwegian study involving 3000 children, in which 99% were exclusively breastfed at birth, and among which, 85% were still at least partially breastfed at 4 months, have showed that only 21% had received solid foods at 4 months. [34]. More recently, in an Italian study of 2450 infants, where 90% were breastfed at birth and 45% at 6 months, it was found 34% of the early rate diversification [21] . The duration of breastfeeding influences the period of the diversification. Skinner [22] found that children breastfed were artificially diversified earlier. One can hypothesize that if the breastfeeding is a satisfaction for the mother and the child, there is no reason to introduce other foods. We may think that women who breastfeed are monitored regularly (promotion of breastfeeding) and they benefit from better information on the current recommendations for infant nutrition.

What are the risks associated with early diversification? During the critical periods of development, a major intake of certain macronutrients such as proteins and lipids can also help to explain the differences in growth between the early and late children diversified. They induce in fact some effects of changes in the hormonal status and in the metabolism of the individual. The excess in too early diversification are characterized by excess of protein intake. In a survey realized in 1997 in France, the authors found themselves that until 5 months, inflows observed in proteins are superior to twice the recommended intake in 75% of children [38] .It has been suggested that excessive consumption of protein contributes to excessive weight gain in the first year of life according to Nielsen in 1998, as well as the metabolic programming of later obesity [24] by stimulating the secretion of insulin and IGF -1. These two hormones play a role in adipogenesis and in the growth acceleration [25]. The low breast milk protein concentration would be associated with lower plasma levels of IGF-1 and insulin, thereby limiting weight gain. However, the dietary diversification period is often characterized by a significant increase in amounts of protein intake between 2 and 4 times more than the recommendations up to ~ 4 g / kg body weight or 16% of total energy in certain types of populations [26]. A recent study showed that high intake of protein between 12 and 24 months was associated with a body mass index (BMI) and at a percentage of the body fat higher than at 7 years [27]. Thus, differences in protein content in milk feeding and at the diversification period can influence the growth both in the short and the long term.

The early food diversification is always accompanied by excess and that goes far beyond the needs and can influence the development of the renal function. During early diversification, the food intake can lead to an excess of sugar. The short-term risk is to reduce the fat intake necessary for infant growth and to increase the sweet appetite. We have seen the role of essential fatty acids on brain maturation. Calcium deficiencies can occur during the period of diversification when parents do not compensate the milky reduction through the introduction of new dairy products, especially when they do not give dairy meal, at least 3 meals of 4. Infant formula or breast feeding are the main source of iron in children from 0 to 3 years. In Canada, the frequency of the iron deficiency is of 5% before one year when it does not exceeds 10% on 2 to 3 years. It exposes the infant to a risk of anemia, to growth retardation, and to a greater susceptibility to respiratory infections and ENT. Finally, the diversification induced a risk of lipid deficiency due to the high proportion of lipids in the milk which is not adequately compensated in diversified diet. We have seen the role of essential fatty acids on brain maturation. According to WHO guidelines in 2006 [28], the beginning of the diversification in a healthy child should not start before six months whether he is or not breastfed. When the diversification is started too early (before 6 months): the main risks are the child's inability to properly digest and metabolize the food that is offered. Another risk consists of the exposure to allergens which the immune system of the child is immature.

Swallowing capacity may still be insufficient for the child foe been able to take pleasure in eating without choking. The Swallowing capacity may still be insufficient for the child to be able to take pleasure in eating without choking. If the proposed foods are unsuitable for the child's age (too salty, too sweet, too concentrated in protein, high fat…): the child would be unable to properly metabolize the food he ingests and may be exposed to kidney and digestive problems. The question of overweight may also arise. In contrast, if the proposed food is insufficiently rich in micronutrients, children are exposed to risks of vitamin and mineral deficiencies (especially iron).

Table 1: Explanatory factors of age diversification and the risk of overweight or obesity in young children from 0 to 42 months in Miramichi. Univariate analysis by logistic regression.

	Crude OR	IC 95%	P
Maternel age			
18-24	0,24	[0,15-0,55]	0,001
25-29	0,97	[0,70-1,75]	0,001
30-34	1	[1,60-2,85]	0,001
≥35	2,23		
Marial statut			
Married	1,97		
Non married	1	[0,50-2,15]	0,001
		[0,60-1,85]	-------
Higest level of education completed			
High School Diploma	1,6	[1,42-2,67]	
University	2.4	[1,90-3,85]	0,001
Community college	3.7	[0,50-4,85]	0,001
Post-graduate	1	-------	0,001
	3.9	[0,50-2,85]	0,001
Total Household Income			
Less than $ 20, 000	1	------	0,001
$ 20,000-$50,000	1,54	[0,15-0,55]	0,001
$ 50,000-$100,000	1,63	[0,50-0,75]	0,001
≥ $100 000	1,9	[0,50-2,85]	
Working Status			
		[0,50-1,85]	0,001
Working Full Time	1,6	[0,50-1,85]	0,001
Working part-Time	2.4	[0,50-2,85]	0,001
Not working	1		
Type of breastfeeding			
- Exclusive	3,1	[0,15-0,55]	0,001
- Non exclusive	1	-------	
Duration of breastfeeding			
- Before 6 months	1	--------	
- After 6 months	2,1	[0,50-2,85]	0,001

Table2: Factors explaining the age of diversification and the risk of obesity in young children from 0 to 42 months in Miramichi. Multivariate analysis by logistic regression

Characteristic	ORa	IC 95%	P
Marital status			
Married	2,97	(0,93-3,1 5)	0,001
No married	1	--	
Higest level of education completed			
Community college	1	--------	
High School Diploma	1,62	(0,95-1,85)	0,001
University	1,96	(1,50-2,75)	0,001
Post-graduate	2,12	(1,95-4,09)	0,001
Working Status			
Working Full Time	1,74	(0,15-2,55)	0,001
Working part-Time	1,63	(0,50-1,75)	0,001
Not working	1	----	
Smoking during pregnancy			
✓ Yes	**3,9**	(1,5-8,1)	0,001
✓ No	**1**	-----	
Type of breastfeeding			
- Exclusive	3,1	(0,15-0,55)	0,001
- Non exclusive	1	-------	
Duration of breastfeeding			
- Before 6 months	1	--------	
- After 6 months	2,1	(0,9 0-2,85)	0,001

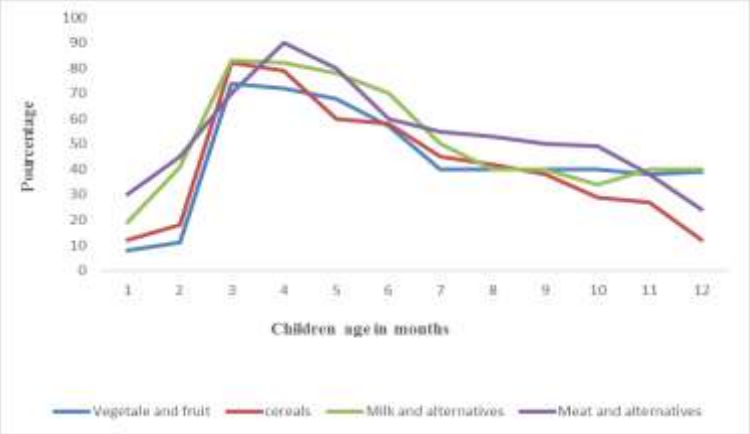

Figure 1: types of food consumed during the food diversification

IV. Conclusion

This study has permitted to highlight the age of diversification in young children in the Miramichi region. In the sample studied, the diversification age is situated at 13 weeks. Furthermore, this study allowed us to identify five factors associated with early age of diversification: the maternal age, the marital status, the highest level of education completed the smoking, the type of breastfeeding and the breastfeeding duration.

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